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Scientists as Midwives to Cluster Emergence: An Institutional Work Framework

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Abstract: The question of how embedded actors can create institutions that support cluster emergence remains unsolved in the cluster and national innovation systems literature. The present paper extends the recent literature on institutional entrepreneurship and institutional work to solve this paradox of embedded agency in the context of science-based clusters. Building on a longitudinal single-case study of a functional foods cluster in Finland, we present an institutional work framework for cluster formation. We argue that, in addition to ideational, material and bridging work, authentic leadership work is critical for cluster emergence. The results of the study highlight the opportunities that scientists have to act as midwives to cluster formation, but they also show that well-functioning clusters need a broader support base.

Key words: institutional entrepreneurship; institutional work; science; clusters; functional foods

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1. Introduction

The prosperity and dynamics of regions is increasingly connected to co-creation of knowledge between public and private actors in science-based clusters. Recent studies have suggested that while there is strong research focus on how clusters function, there is a noticeable disregard for how clusters actually become clusters (Menzel and Fornahl, 2009; Feldman and Lendel, 2010). In analysing the origins of science-based clusters, the present study draws on neoinstitutional theory. The context of science is highly institutionalised, which makes it interesting to study little-documented practices through which actors engage in the disruption of institutions (Lawrence and Suddaby, 2006; Oliver, 1992) and the creation of new institutions to support cluster emergence.

Studies on clusters and national innovation systems have highlighted the important role which institutions that facilitate learning, knowledge sharing, and identity building play in the success of science and technology-based clusters (e.g. Saxenian, 1994; Lundvall, 2007; Edquist, 1997; Breznitz, 2005; Myteka, 2006). Despite the emergence of consensus regarding the critical role of institutions, few studies have focused on the internal processes by which new institutions are created and spread (Parker, 2010). For instance, the circular reinforcement of national innovation systems literature is hard-pressed to explain how embedded actors can gain sufficient detachment to disrupt institutions and create new institutions from within (Hung and Whittington, 2011, p. 527; Casper and Kettler, 2001).

In order to address this paradox of embedded agency – that is, "How can actors envision and enact changes in institutions if their actions, intentions, and rationality are all conditioned by the very institution they wish to change?" (Holm, 1995, p. 389) – the present study builds on the literature on institutional entrepreneurship and institutional work (DiMaggio 1988; Lawrence and Suddaby, 2006; Greenwood and Suddaby, 2006; Tracey et al., 2011; Hung and Wittington, 2011). Rather than conceptualising clusters primarily as concentrations of interlinked industries that produce similar or complementary outputs, we define them as agglomerations of professionals; that is, practitioners

that belong to the same or related epistemic communities (Håkanson, 2005; Amin and Cohendet, 2005).

The present work is a case study of the success and limitations of cluster building through institutional agency exercised by scientists. Using qualitative procedures, we unlock the micro-process of cluster emergence around functional foods in Finland from the early 1970s to the present, with a focus on the pre-cluster formation stage. Functional foods include a range of products from naturally healthy foods to foods that have had active components added using chemistry, biotechnology and nutritional genomics. The considerable economic burden of healthcare spending created by life-style-related diseases and an ageing population has added functional foods to the public research agenda. Many countries have used Finland as a role model to boost innovations (Brännback and Carsrud, 2008), and the country has continuously ranked in the top positions in the World Competitiveness Report. Despite being nicknamed “the Silicon Valley of Functional Foods”, the cluster formation in functional foods in Finland has faced some serious challenges, which provides an interesting context in which to study institutional entrepreneurship, which was only partly successful.

The argument proposed here is that instead of the pure knowledge-generating work that scientists are typically associated with, their “institutional work, i.e. their purposive acts aimed at creating, maintaining and disrupting institutions” (Lawrence and Suddaby, 2006, p. 215), has a significant impact on the emergence of science-based clusters. The key research question we set out to answer is: *"When scientists build new science-based clusters, what forms of institutional work are used in the process?"*

In this article, we highlight the role of authenticity and authentic leadership (Avolio and Gardner, 2005; Luthans, 2002) of institutional entrepreneurs in a cluster emergence process. To date, cluster research has focused on leadership issues to a surprisingly minimal degree, despite its crucial role in cluster formation (Suder et al., 2011). Our study adds to the few that have investigated internal institutional change processes (Parker, 2010; Hung and Whittington, 2011) and the pre-emergence

stage of clusters (Menzel and Fornahl, 2009). We contribute to the institutional literature by exploring the important yet understudied interaction between institutional agency and regions. The study also addresses an increasingly prevalent, yet under-examined context of cluster formation, which is cluster emergence around societal problems. By extending Hoffman's (1999) argument that new fields form around common issues rather than technologies or industries, we show how a science-based cluster started to emerge around a pressing societal problem. We suggest that the original trigger for cluster emergence lies within the socio-cultural environment, which was framed as an issue by individual scientists acting as issue sponsors (Dutton, 1993). Hence, we join those that have emphasised the criticality of a regions' capacity to detect problems and implement solutions that lead to the formation of new clusters (Parker, 2010).

2. Theoretical Context: Institutional Agency and Cluster emergence

2.1. Science as a Stage for Institutional Entrepreneurship

The institutional entrepreneurship literature suggests that new institutions arise when socially skilled actors with sufficient interest and resources see an opportunity to realise interests that they value highly (DiMaggio, 1988). With a few exceptions (Jain and George, 2007; Ritvala and Granqvist, 2009), the field of science has been neglected in the study of institutional entrepreneurship. Similarly, clusters and national innovation systems have been an undertheorised context of institutional entrepreneurship, with a few exceptions (Robinson et al., 2007; Hung and Wittington, 2011). From Kuhn's (1962) perspective, institutional entrepreneurs are those that participate in paradigmatic changes and argue for new relevant research questions, how they should be investigated and how results should be interpreted. This requires strong institutional agency, given that science is a highly institutionalised area of human endeavour with established and embedded professional norms and

practices. A lack of knowledge remains regarding how the activities of individual scientists acting as institutional entrepreneurs gain the momentum that enables cluster emergence.

2.2. Institutional Work in Cluster Formation

The concept of institutional work shifts attention away from the dramatic actions of "heroic" entrepreneurs in the institutional entrepreneurship literature to broaden the range of actors involved in influencing institutions (Lawrence et al., 2009; Riaz et al., 2011). The collective aspect of institutional work is foundational to our study of cluster emergence, which requires the participation of diverse types of actors who transform institutions in the course of their everyday work. Although institutional work aims to affect the institutional order, it represents "a complex mélange of forms of agency – successful and not, simultaneously radical and conservative, strategic and emotional, full of compromises, and rife with unintended consequences" (Lawrence et al., 2011, p. 52). Despite broad insights regarding the multitude of forms of institutional work, there is only minimal understanding of why certain actors engage in institutional work while others do not (Riaz et al., 2011; Lawrence et al., 2009). The institutional work framework for cluster formation that is developed below, builds on the previous studies and our empirical case. It suggests the notion of *authentic leadership* to uncover the motivations and capacities needed to carry out institutional work in cluster emergence.

2.3. Institutional Work Framework for Cluster Formation

The institutional work framework for cluster formation highlights the role of institutional agency that individual scientists play in issue interpretation and solving, and in preparing the ground for subsequent networking between actors in technological and business innovation. Figure 1 illustrates this framework. The starting point for the cluster formation process around societal problems starts by identifying a common issue (Hoffman, 1999; Atherton, 2003; Myteka, 2006; Parker, 2010). This

is followed by issue interpretation and solving by scientists where they engage in four broad forms of institutional work: (1) *issue framing and counterfactual thinking,* (2) *resource mobilisation,* (3) *bridging and networking*, and (4) *authentic leadership.* While recent studies have identified the first three categories as central forms of institutional agency (Tracey et al., 2011; Hung and Whittington, 2011), we suggest that authentic leadership is a fundamental driver and carrier of cluster development. In the context of science-based clusters, institutional work by scientists involves interaction with global epistemic communities and translation of knowledge-based ideas across spatial scale to make them fit local actors and institutions. Along the cluster formation process, the forms of institutional work move towards increasing collaboration horizontally within and between industries, broader advocacy and education of new business and societal opportunities, as well as the construction of a new collective identity for the cluster(Lawrence and Suddaby, 2006; Arbuthnott et al., 2010; Romanelli and Khessina, 2005). However, cluster emergence is seldom a linear process; instead, it may involve discontinuities or "sticking points" (Atherton, 2003) when cluster participants are unprepared or unwilling to move to the next cluster stage. The next part of the paper discusses the four forms of institutional work further.

Figure 1 around here

2.3.1. Issue Framing and Counterfactual Thinking

Identification of common issues and crafting of related problem or opportunity framing strategies are important acts for institutional entrepreneurs who aim to change the social structures in which they are embedded (Tracey et al., 2011; Hung and Whittington, 2011). Frames are schemata of interpretation that guide individual or collective action by rendering events meaningful (Snow et al., 1986). Skilful framing makes it possible to build a shared understanding of the problem (diagnostic framing), who or what is to be blamed (prognostic framing), and urge others to act in concert for

issue solving (motivational framing) (Benford and Snow, 2000). Framing involves theorisation; that is, the process whereby organisational failings are specified and linked to potential solutions (Greenwood et al., 2002). In the context of societal issue solving, theorisation and motivational framing has been found to require counterfactual thinking − challenging assumptions, investigating underlying causes and generating proactive solutions (Tracey et al., 2011). In the case of science-driven issues, scientists are typically the only legitimate actors to theorise causal relationships and possible solutions.

2.3.2. Resource Mobilisation

One of the central tasks of an institutional entrepreneur is to find and secure sufficient resources – cognitive, social and material support – to change existing and to create new institutions. The existing literature uses terms such as leveraging (DiMaggio, 1988), accumulating (Van de Ven and Garud, 1993), convening (Westely and Vredenburg, 1997; Dorado, 2005) and aggregating (Hung and Whittington, 2011), but scholars generally agree that resource mobilisation is a highly political and uncertain process (Fligstein, 1997). In securing material support, scientists typically possess a key role in building support infrastructure for clusters, such as major laboratories, and competencies, that shape future trajectories (Robinson et al., 2007). They also mobilise support (material and nonmaterial) from a region's existing actors and industries (Arbuttnott et al., 2010). Respectively, the support of scientists is needed to build markets around inventions within clusters, as markets require specific institutions and rules in order to come into existence (North, 1990; Fligstein, 1997).

2.3.3. Bridging and Networking

Research on institutional entrepreneurship has found that brokerage between dispersed ideas and actors is an essential element of entrepreneurial success (Greenwood and Suddaby, 2006), social problem solving (Maguire et al., 2004; Tracey et al., 2011), and the dynamics of spatial innovation systems (Arbuthnott et al., 2010; Hung and Whittington, 2011). While bridging refers to more ideational work, networking implies social interaction, often between previously unconnected actors.

The rules of membership define organisational fields (Lawrence, 1999), which makes networking an important form of institutional work in cluster formation. Professionals with long histories in serving elites are uniquely positioned to act as brokers between social structures of hierarchy and status, and therefore act as key drivers of institutional change through advocacy (Suddaby and Viale, 2011). As members of global epistemic communities, scientists are also well positioned to act as a bridge between spatial scales (Bunnell and Coe, 2001; Håkanson, 2005). While such "spatial work" is rarely discussed within neoinstitutional theory, economic geography increasingly stresses access to "global pipelines" or globally configured knowledge communities (Bathelt et al., 2004; Gertler and Levitte, 2005; Vang and Chaminade, 2007; Moodysson, 2008).

2.3.4. Authentic Leadership

There is a rich body of literature suggesting the crucial role of individual scientists in path-creation processes of new technologies and high-tech regions. Typically, these accounts emphasise the role of a "star" scientist (Zucker et al., 2002) or an individual with high prestige and a vision – like Frederick Terman, the Provost of Stanford – in developing a region from its science base to flourishing business region (Leslie and Kargon, 1996; Adams, 2005; Etzkowitz, 2006). Similarly, the failure of clusters has been partially attributed to the lack of such entrepreneurial orientation to commercial application and focus on pure scientific programmes by scientists (Feldman et al., 2005). Studies by Garud and Rappa (1994) and Garud and Ahlstrom (1997) emphasise that scientists must create and believe in their own realities in order to make progress in their chosen paths and convince others. This emphasises the role of authenticity; that is, the distinctive and truthful expression of identity to various audiences (Svejenova, 2005).

The argument that authenticity is central for successful mobilisation can be found in the authentic leadership literature, which has roots in positive psychology (Avolio and Gardner, 2005; Luthans, 2002). Authentic leaders have the ability to consider multiple sides of an issue, and have the positive psychological capacities of confidence, optimism, hope and resiliency (Avolio and Gardner, 2005). They do not engage in leadership activities for status, honour or other personal rewards, but rather,

they lead from a conviction (Shamir and Eilam, 2005). While framing, resource mobilisation, bridging and networking are conscious and strategic activities, authentic leadership is more an unconscious activity and an enabling psychological capacity of individual institutional entrepreneurs.

3. **Research Strategy**

This paper follows a longitudinal single case study design, which suits our theory-building aim (Dyer and Wilkins, 1991). This approach avoids temporal reductionism (Granovetter, 1992), and responds to calls for longitudinal analysis to properly capture cluster emergence (Håkanson, 2005). We express what we see in the language of existing concepts and add our own observations (Locke, 2007, Pettigrew, 1997). The study covers the theoretical middle-range (Bourgeois, 1979, Chau and Witcher, 2005) in that we aim to understand cluster emergence in its unique context.

3.1. Context

This study focuses on cholesterol-lowering functional foods, where the active ingredient of plant stanol ester is added to block the absorption of so-called bad cholesterol (Miettinen et al., 1995). A high level of blood cholesterol is a major risk factor for heart disease. We concentrate on one functional foods category, which came to symbolise the potential of functional foods. Yet, Finland's competence in functional foods extends beyond cholesterol-lowering (e.g. dental health, wellbeing of the gastrointestinal tract and dietary fibre). Further, the aspiration to build functional foods clusters is a worldwide phenomenon, with significant resources being invested for instance in Saskatoon (Canada) and the Øresund region, around Malmö in Sweden and Copenhagen in Denmark (Lagnevik et al., 2003).

3.2. Data Collection and Analysis

This study draws from three sources of data: interviews, participant-observation and secondary data. In total, 35 in-depth semi-structured interviews were conducted. Informants included principal investigators of a heart health initiative called the North Karelia Project; senior firm management; professors of medicine, food chemistry and functional foods; and managers of cluster initiatives. The interview sessions lasted approximately two hours each. Interview themes covered (1) historical and recent developments in cluster emergence, (2) the key actors and their roles and activities in the emergence process, and (3) the future of the cluster development. The main data collection phase took place between 2004 and 2008. Two additional post-study interviews took place in 2012 in order to engage the key field insiders in critical self-reflection and in the reflection of outcomes of cluster initiatives.

The second source of data is formed by participant observation, which was conducted between 2005 and 2008 in five separate networking events organised by the Finnish National Fund for Research and Development (SITRA) and the Finnish Export Organization Finpro. It complemented other data sources by enabling the observation of social intercourse, values and motivations of actors in their social context. Thirdly, we relied on documents such as the evaluation reports of technology programmes and meeting memorandums to complement our understanding of the emerging cluster (e.g., Hernesniemi, 2004; Lagnevik et al., 2003; Heasman, 1999).

Data analysis was an iterative process, following Langley's (1999) recommendations for process research. Initially, we built an event history database (Van de Ven and Poole, 1990) in which we collected key events and actors (Table 1). The aim was to trace back the roots of institutional change and scientific advancement that later triggered the cluster emergence. Three key phases were identified: the issue network that emerged in the province of North Karelia in the 1970s, the interdisciplinary innovation network in the late 1980s, and the publicly funded cluster initiatives since the late 1990s.

Table 1 around here

In the second stage, the three identified phases were re-examined with the help of tentative patterns that emerged from the data and theoretical concepts drawn from the literature. In the third stage, creativity and insight were harnessed in order to refine the different forms of institutional work that scientist were engaged in during cluster emergence. Our theorising process corresponds closely with the three interconnected processes identified by Langley (1999): induction, deduction, and inspiration driven by creativity.

4. Case Study: Institutional Work in the Functional Foods Cluster

4.1. Gestation Phase: Institutional Work to Change Food Habits for Improved Public Health, Early 1970s–Late 1980s

"*One of Finland's characteristics – and advantages – is that its companies work in a Silicon Valley-type partnership with academia and government agencies […] Many readers will have heard of the North Karelia project, a public health initiative dating back to the 1970s that set out to reduce the extremely high levels of heart disease in that region of Finland. This twenty-year focus on health has produced fertile ground for the development of a Finnish nutrition industry."* – Industry analyst Dr. Julian Mellentin (2003, p.1)

4.1.1. North-Karelia Project − Brief Overview

In the 1950s, a new public health problem emerged in industrialised countries: the epidemic spread of coronary heart disease, particularly among middle-aged men. This was the catalyst for research into the causes of heart disease. The urgency triggered a novel form of collaboration among academy, industry and civil society, sowing the seeds for the future cluster in functional foods.

In the 1960s, the mortality rate from heart disease in North Karelia in Eastern Finland, was the highest in the world (Puska, 2008). After World War II, people adopted fatty foods and heavy smoking, leading to a peak in heart disease. In January 1971, local politicians and civil society leaders signed a petition for urgent state aid. The North Karelia Project was launched in 1972 by Finnish authorities and experts, with the help of the World Health Organisation (WHO). The aims of the North Karelia Project were to improve the detection and control of hypertension, to reduce smoking and to promote diets that were lower in saturated fat and higher in vegetables and low-fat products (McAlister et al., 1982). Meeting these aims necessitated the creation of a radically new community intervention approach and strong long-term leadership.

4.1.2. Issue Framing and Counterfactual Thinking in "Shotgun Prevention"

The common belief in medical circles at the start of the North Karelia project was that the success of any heart disease prevention attempt is uncertain at best. Indeed, the concept of community-based prevention was new and lacked legitimacy among cardiologists. It raised both ideological questions (the ethics of influencing people's dietary habits) and methodological ones (addressing the whole community instead of treating one patient). As the Co-principal investigator of the project told us, the young scientists involved in the project in the 1970s were referred to as "Young Hooligans" who "took a big risk, because there was only scant evidence that blood pressure, cholesterol, and the use of tobacco might be the underlying factors [for heart disease]" The project team thought otherwise and felt it was obvious that clinical treatment of heart disease dealt with consequences rather than causes. It was not enough to work solely with "clinically high risk" individuals; a population-based approach was required. This meant changing general lifestyle patterns in North Karelia. In the 1970s, such a "community-based approach" approach was considered so radical that a 1973 editorial in the *International Journal of Epidemiology* denounced it as "shotgun prevention" (Oppenheimer et al., 2011). The key form of institutional work included educating people about the relationship between lifestyle and heart health. Key channels of influence included discursive acts and "face-giving" by the project team in the local and national media. In the

1980s, the project hosted national risk-reduction TV shows, where special attention was given to infusing optimism and confidence.

Representatives of WHO and local medical doctors were invited to give testimony in local meetings in order to persuade the people to change their lifestyles. This was a strong form of disrupting institutions by questioning the moral foundations of existing eating habits and decreasing the perceived risk of the proposed lifestyle (Lawrence and Suddaby, 2006). In motivational framing, attention was paid to emotional aspects deeply embedded in the local culture. Many North Karelians felt “I am in the project” (Puska et al. 2009, p. 286), which was a powerful motivation for other people to join. Framing activities also involved legitimising the pioneering community approach among scholars.

4.1.3. Bridging, Networking and Resource Mobilisation

The key insight of the community approach was that an individual’s behaviour cannot be changed simply by providing information; he/she needs to be persuaded to change his/her behaviour and be convinced that the new ideas are socially acceptable (McAlister et al., 1982). An interdisciplinary approach that simultaneously applied medical and behavioural and social knowledge was used to design the process. Everett M. Rogers, the innovation diffusion theory guru, was involved in the project (see Rogers, 2003). The key strategy was to use 800 lay opinion leaders, educated by a local NGO. At the same time, the project was linked with public administrative structures and health authorities, including local nurses and physicians. The key strategy in resource mobilisation was to make the project a national-level one with government involvement in order to secure long-term funding.

4.1.4. Authentic Leadership

The key designer of the North Karelia Project was Professor Martti Karvonen, a highly respected cardiologist. Karvonen understood that a deep societal transformation was needed among North Karelians, which required dedicated long-term leadership. Karvonen invited a young physician and social scientist named Pekka Puska to become the principal investigator of the project. Puska, then a 27-year-old public health physician, also had a master's degree in political science. He had been actively involved in student politics during the time of unrest in universities and believed strongly that highly entrenched institutions could be changed.

Authentic leadership meant that Puska and his young project team members devoted their full attention to fundamental change based on ideas hardly mentioned during their medical studies. It also required the ability to consider multiple sides of the issue as described by Puska: *"The guiding principle was situational sensitivity − knowing really what others think, not what it looked like, but what it actually was. The other principle was that in your heart you understood that people were different … you needed to get everyone work in from their own starting points."*

The young and inexperienced project team faced opposition and suspicion from many sources beyond scientific and grassroots communities, particularly from the National Farmers Union and the dairy industry. This was not surprising, given that the message to change from consuming butter and whole milk to margarine and fat-free milk was seen as a main threat to their business. Puska's political background was invaluable in breaking down the resistance, which also required persistence and frequent visits to the dairy farmers, local food manufacturers and retailers. Instead of blaming the farmers or the food industry, the project team challenged them to develop healthier food, thus paving the way to the concept of functional foods. Puska firmly believed in the importance of personal involvement what he called 'boots-deep in the mud' philosophy. His guiding principle was to transfer knowledge from pure research to the daily life of people. The project's success was largely based on personal contacts and trust, as well as finding win-win situations for the participants. Besides his leadership tasks, Puska co-authored several hundred articles on the project.

4.2. Pre-emergence Phase: Innovating at the Interface between Industries, 1989–1995

4.2.1. Benecol Story − Brief Overview

The public health efforts and the issue network created in North Karelia produced a fertile ground for deeper university-government-industry relationships, and for the development of health foods. In the late 1980s, a new vegetable oil was developed made of rapeseed, which grows well in the Finnish climate. In 1988, the firm Raisio began a research programme on rapeseed oil. Raisio invested heavily in a new pilot laboratory and factory, which became crucial in the development of cholesterol-lowering margarine Benecol, later selected as one of the top 10 food inventions in the world (Hyytiäinen et al., 2012).

4.2.2. Bridging, Networking and Resource Mobilisation

The development of Benecol started in 1986 based on a Finnish pulp and paper mill's need to find a suitable application and buyer for sitosterol, the surplus by-product of its milling process. The cholesterol-lowering effect of sitosterol had been identified in the 1950s, but the substance had poor solubility. The mill's plant manager contacted Professor Tatu Miettinen and his research group at the Helsinki University Central Hospital (HUCS), which had studied cholesterol metabolism for decades.

However, there was a considerable technical roadblock as there was no appropriate method to convert sitosterol in food. In 1989, Ingmar Wester, a chemist and R&D manager of Raisio, found the solution for converting sitosterol into a fat-soluble form. It is worth noting that at that time, Raisio had no ambition to create any functional foods business, but instead wanted to raise the image of its margarine segment. Raisio was particularly concerned about the expensive clinical trials needed. However, the Finnish Funding Agency for Technology and Innovation (TEKES) provided funding for the expensive clinical trials for the first time, so the Benecol project gained momentum.

While Miettinen was responsible for early clinical testing of Benecol at HUCS, a larger population trial was needed. When Wester inquired about the possibility of testing the cholesterol-lowering effect

of Benecol within the North Karelia project, Puska was immediately enthusiastic. Clinical trials were necessary not only to confirm the safety and efficacy of the product, but also to convince consumers, the medical community and, not least, the directors and stakeholders of Raisio to invest in the product (Hyytiäinen et al., 2012). The positive results of the clinical trial were published in the *New England Journal of Medicine* (Miettinen *et al.,* 1995) and received much attention. Raisio's deputy chief executive at the time told the *New York Times*: "*It is like an atomic bomb we didn't mean to invent […] We were just looking for a better margarine. We never thought it would be that big."*

4.2.3. Authentic leadership: Bridging the Gap between Epistemic Communities

In this phase, the key form of institutional work was the merging of previously decoupled logics, namely those of medicine, pulp and paper, and food chemistry. Combining these logics required a wide competence base and the courage to look beyond disciplinary boundaries. It also required strong credibility as an altruistic scientist. Miettinen had devoted his life to medicine, scholarship and teaching and, as we were told, Miettinen worked for the love, not for profit: *"It* [the perceived greed of medical doctors] *can also destroy the whole thing* […] *In the Benecol case, the personality of Tatu Miettinen was such that no one had anything against him. Everybody knew that he only got a small lump sum for it* [the invention] *and no royalties afterwards."* – Director of an industry association

The key scientists were not afraid to stake their credibility on building the market for functional foods. At the same time as the *NJEM* article was published, Benecol margarine was launched in Finland. A one-page advertisement included pictures of Professors Puska and Miettinen, with a headline asking: "*Why do we recommend Benecol margarine for three out of four Finns?"* (Lehenkari 2003, p. 514). This legitimation was highly appreciated by industry, as described to us by a Sales Director: "*If I must name one key person, it is Pekka Puska, absolutely. That Finland has become a model country for functional foods and this kind of innovation hot spot is very much about Pekka Puska… Rather than blaming the food industry*, *he challenged the food industry to produce healthier foods. He created the motivation and need [for functional foods].*"

The example of Benecol encouraged the Finnish food industry to develop new functional food items on broad fronts. The concept also had an important indirect impact on the policy changes, by increasing public funding of industrial R&D and by triggering Finland's first technology programme in foods.

4.3. Lock-In Phase: Engaging Industry through Cluster Programmes, 1996–2010

"*One of the biggest surprises from my research was the level of secrecy and lack of co-operation in Finland's food industry. At first glance, it seems the opposite is true. Finland is a small country, has well established professional networks and key people all know each other. There are also examples of how, through word of mouth, such as a university professor suggesting an idea, companies have developed new products. But it ends there."* – Industry analyst Dr. Michael Heasman (2000, p. 23).

4.3.1. The Finnish Innovation Environment − Brief Overview

Since the 1990s, the concepts of industrial clusters and national innovation system have become key policy frameworks in Finland. In response to the economic crisis in the early 1990s, the government started to implement an endogenous, top-down planned, systemic innovation policy in order to restructure the economy away from excessive reliance on natural resources towards science-based R&D (Coenen and Asheim, 2006). The National Industrial Strategy for Finland, published in 1993, redefined industrial policy along the lines of the Porterian industrial clusters (Ylä-Anttila and Palmberg, 2007). This development saw the growing importance of TEKES, in fact, for three decades new technology programmes or activities have been introduced annually (Brännback and Carsrud, 2008; Lemola, 2003). In the late 1990s, attempts at cluster formation around functional foods also magnified. While policy efforts made Finland a much-cited success-story internationally due to intensive cooperation among universities, industry and research institutes, the attempts at cluster formation in functional foods faced severe challenges. Indeed, the period between the late

1990s and 2010 saw moves towards institutional consolidation of the infant functional foods cluster and the subsequent decline caused by mutually incoherent local agendas.

4.3.2. Resource Mobilisation, Networking and Framing

When Finland joined the European Union in 1995, the market that had been protected by high import barriers was opened to international competition and the industry realised the benefits of joining forces. However, while cooperation between the academy and the industry was initiated, old inward-looking attitudes still persisted. This meant that, initially, ideas were not exchanged openly, differences in terminology of the industry and research hampered cooperation efforts, and there was minimal exchange of technology and know-how (Hyytiäinen et al., 2012).

However, a more cooperative atmosphere was gradually created along with the use of positive motivational frames (e.g. “Silicon Valley of Functional Foods”). Continuing the work carried out by TEKES, SITRA launched another four-year cluster programme in 2004. One of the central aims of the programme was to establish a Strategic Centre for Science, Technology and Innovation in the field of food and nutrition in Finland. By late 2008, however, it became clear that the joint strategic research centre would not materialise. One explanation was that firms were unwilling to invest in something that transcended the boundaries of their own firms.

4.3.3. Authentic Leadership: Fighting Entrenched Mindsets

“*There is this old monopoly history, not-invented here syndrome, and a lot of inward looking.”* (Director of a Cluster Programme) “*When firms get involved [in the cluster initiatives*] *they start to jealously protect their own interests...There is this inability to see beyond these traditional boundaries*”. (Chairman of the Board)

The unwillingness of firms to look beyond their boundaries and their disagreement on trajectories negatively impacted the cluster formation (Garud and Ahlstrom, 1997, Garud et al., 2002). There were also doubts about the efficiency of the cluster initiatives as described by an interviewee: "*Along cluster initiatives a large amount of me-too products were financed…We've been the giving side in them*". Overall, there seemed to be little authentic leadership apart from general optimism frames (e.g. Finland − a forerunner in healthy nutrition). We also found evidence that the move towards formalising the cluster was detrimental to its further development, as illustrated by this quote: "*Every now and then they call and ask me to participate in these groups where they consider or brainstorm this and that- and I've refused politely. I've not bothered to participate, partly due to time pressure. But I'm very sceptical that in this way things will fly – concrete actions are needed in a natural way*". – Managing Director.

4.3.4. Postscript

Despite the setbacks, functional food actors continue to invest in creating new health promoting innovations. Also TEKES considers whether to again set up a new technology programme, while also asking: "*Should artificial respiration be stopped if the industry's willingness to invest is minimal* (Hyytiäinen et al., 2012, p. 57)?" The industry also sees potential in functional foods, even though the field has suffered from a slight downturn, corresponding to the European paradox,[1] where limited flow-through to economic development is achieved, despite relatively high R&D spending (Etzkowitz and Klofsten, 2005). This development parallels with low entrepreneurial activity. While a closely knit community of professionals in functional foods has formed, it is populated by successful researchers who seemed to want to become even more successful researchers rather than entrepreneurs (see also Brännback and Carsrud, 2008). The individual scientists' institutional work, in itself, had not been sufficient to bring the cluster to the next level.

[1] The authors are grateful to an anonymous reviewer for this comment.

5. Discussion and Conclusion

We now return to our research question, "*When scientists build new science-based clusters what forms of institutional work are used in the process?"* Table 2 compares the three phases of the narrative by analysing the institutional work performed by the scientists. It suggests that the scientists engaged in four broad forms of institutional work: *ideational* (framing and counterfactual thinking), *material* (resource mobilisation), *bridging* (bridging and networking), and *authentic leadership*.

Table 2 around here

5.1. Ideational, material, and bridging work of scientists

The actual forms that institutional work took were closely related to the original triggers. While social and technological problems drove the developments in the first two phases, the last phase was triggered by competitiveness concerns. Consequently, it was necessary in the first two phases to exercise science-based counterfactual thinking and to create concrete and persuasive − even emotional − frames to mobilise actors in issue solving. In the first phase, institutional work furthered a paradigmatic change (Kuhn, 1962) and required a mindset close to Schumpeter's "creative destruction" (questioning established truths and counteracting prevailing practices). This necessitated a combination of micro-, meso-, and macrolevel institutional work to secure cognitive, social and material support for the project. In the last phase, ideational and material work was more narrow emphasizing Silicon Valley rhetoric and channelling of government funding. National-level technology programmes were perceived as distant and conflict-prone, a finding, which is reminiscent of Lorenzen's (2007) argument that the collective non-proprietary dimension of social capital often develops at spatial scales lower than the national scale.

Our findings emphasise the role of scientists acting as institutional entrepreneurs by bridging epistemic and disciplinary boundaries and bringing together hitherto disconnected organisations and individuals. While resembling previous accounts of bridging and networking processes of institutional entrepreneurs (Tracey et al., 2011; Hung and Whittington, 2011), our analysis revealed a broader and differently phased institutional agency. Interestingly, the collaboration and legitimacy building identified started at the institutional level by allying with highly respected organisations such as WHO. This was required to defeat the strong scepticism present both at the level of grassroots and epistemic communities. While during the first two phases, institutional work took place in dialogue with the global science-base, capitalising on the skills of scientists to work across the spatial scale (Ritvala and Granqvist, 2009), the national technology programmes promoted few international links. Overall, the limited participation of international food companies in the Finnish cluster may partly explain the modest success in the cluster building attempts (Mudambi and Swift, 2012).

5.2. Authenticity: The person behind institutional work

Our findings underline the role of institutional work of scientists in the form of authentic leadership. The successful phases of cluster emergence were strongly personified with few scientists who orchestrated rebellious acts to change the shared disciplinary rules and conventions. However, while Puska enjoyed being in the spotlight, Miettinen and Wester were quite the opposite. Nonetheless, all of these individuals shared a common characteristic of being “in tune” with their basic nature (Avolio and Gardner, 2005, p. 319); that is, authentic to their inner missions and identities as scientists. Authenticity, the distinctive and truthful expression of identity to various audiences (Svejenova, 2005), created legitimacy and encouraged others to join their missions. Different phases of cluster emergence seem to require the involvement of different types of personalities: from early radicals who identify issues, to hard-working scientists tackling a knowledge problem, to visionary leaders. Personal traits may also be connected to a peculiar role for scientists in cluster emergence of being an “icon”. Icons are the “spiritual fathers” or institutional catalysts of clusters. Hecht (2008)

argued that non-scientific attributes are the basis of the appeal of scientific icons. For example, Robert Oppenheimer has been portrayed as humanist, moralist, patriot, intellectual, adventurer, or activist – something other than just a scientist. Gaining the status of icon makes it necessary to reveal a persona outside of science in order for the individual to be admired as a scientist (Hecht, 2008). Such symbolising does not include active agency, as previously discussed under the heading of institutional entrepreneurship. Icons also link clusters to more global developments through scientific and popular discourses, which affects the way in which a region projects its identity to both internal and external observers (Romanelli and Khessina, 2005).

Overall, our analysis has shown that scientists who act as institutional entrepreneurs can play key roles in sowing the seeds of new clusters. Eventually, however, this is not enough. Scientists are only able to act as midwives; the long term survival of the cluster depends on the commitments made by private firms, which often requires institutional grounding in something beyond local profit rationales. This could partly explain why a surge of innovative activity within clusters is frequently followed by a collapse (Pouder and St. John, 1996; Audretch and Feldman, 1996).

5.3. Conclusion

This study responds to calls for more nuanced understanding of how embedded actors may change institutions within geographically delimited spaces such as clusters (Hung and Whittington, 2011; Casper and Kettler, 2001). The present study used the concept of institutional work, inspired by the sociology of practice (Lawrence and Suddaby, 2006) to understand how scientists framed, theorised, and built new bridges through their everyday activities. While the study contributes to this stream of research by discussing the role of authentic leadership as a form of institutional work, it also contributes to the cluster literature by showing that not just anyone has the entrepreneurial ability and personal character to contribute to cluster formation.

The study raises some intriguing possibilities for future research. Firstly, the important role of personal traits and inner motivations of institutional entrepreneurs challenges the

rationalistic approach to institutional entrepreneurship by stressing the unplanned, highly personal and intuitive nature of institutional agency. More research is needed on the motivation and characters of institutional entrepreneurs. Secondly, our analysis revealed that early gestation phase of cluster emergence was about mobilising a social movement to influence policy makers and business actors. This suggests an interesting avenue for investigating further how social movements trigger the emergence of new clusters. Thirdly, we posit that problem-driven origins of clusters will become increasingly prevalent in the future; for instance, climate change and other major environmental threats have triggered the emergence of clean technology clusters. Such problem-based approach opens new avenues in which to build good theory, which come from engagement with real problems of the world (Kilduff, 2006).

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Figure 1. Institutional work framework for cluster formation

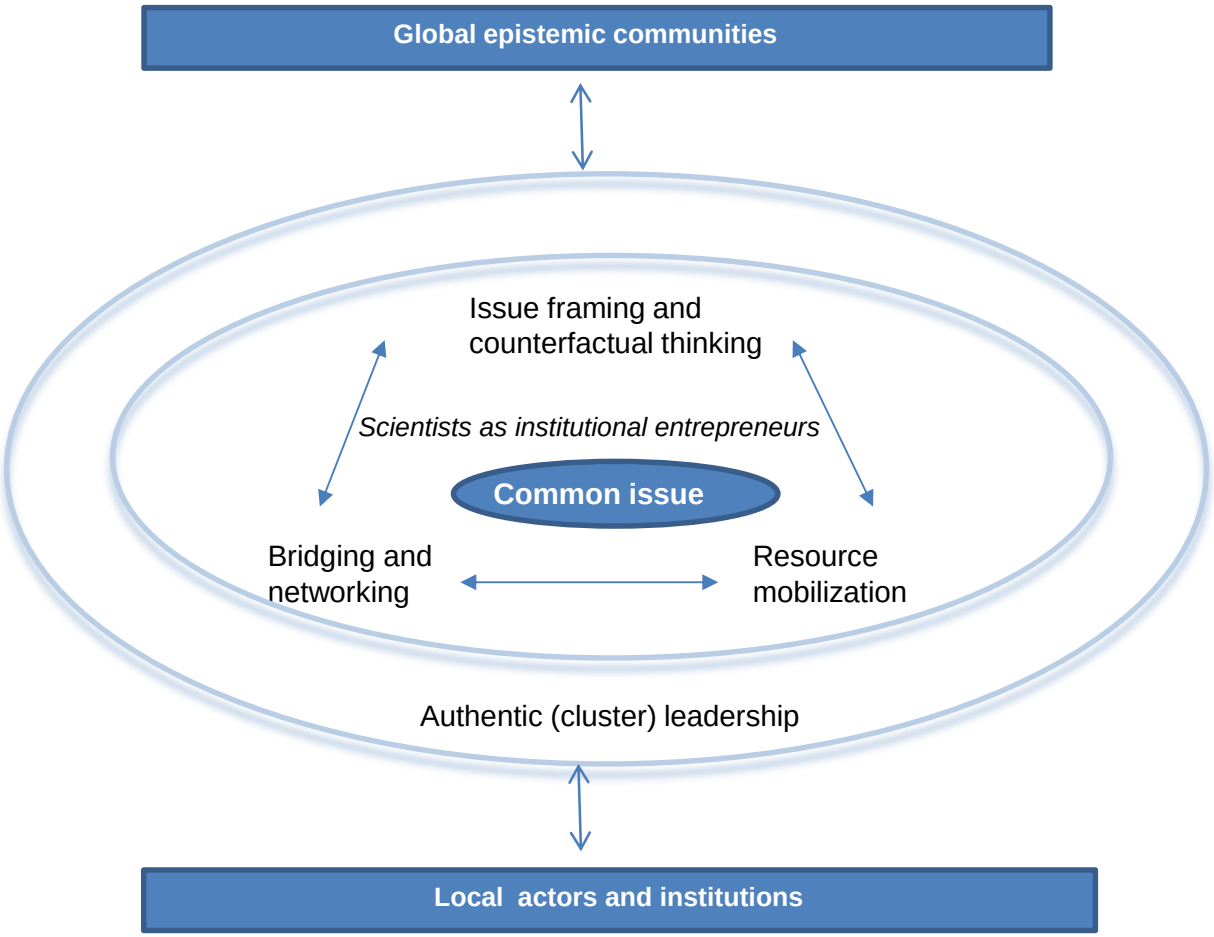
Global epistemic communities
Issue framing and
counterfactual thinking
Scientists as institutional entrepreneurs
Common issue
Bridging and
networking
Resource
mobilization
Authentic (cluster) leadership
Local actors and institutions

Table 1. Chronology of key events

Year	Selected key events and actor(s)	Importance for cluster emergence
1950s-1970s		
1952	A. Keys publishes hypothesis that consumption of dietary fat causes coronary heart disease	Relationship between lifestyle, diet and health claimed for the first time
1954	Meeting of Professors Martti J. Karvonen and Ancel Keys in Minnesota	Finland participates in a pre-study of the Seven Countries Study where the relatiomship between lifestyle, diet and heart disease examined in different populations
1971	Petition signed for urgent measures in North Karelia Region	Political pressure for government participation in solving the pressing local health issue
1972-	North Karelia Project starts under the direction of Dr Pekka Puska	Broad cooperation across public, private and third sectors and the starting of new debate and research on the relationship between lifestyle, diet and hearth health
1980s-1995		
1983	Establishment of Technology Development Center, current Finnish Funding Agency for Technology and Innovation, TEKES	Transition from a science to technology policy orientation. Focus on spurring and aiding new emerging fields with public intervention
1988	"Great fat debate" in the leading Finnish newspaper *Helsingin Sanomat* triggered by the North Karelia project	Rapid increase of cholesterol awareness by the general public
1988	Rapeseed oil developed, Raisio starts a new research programme on rapeseed oil	New competences built for the later cholesterol-lowering functional foods innovation
1989	Process invention by Ingmar Wester at Raisio, enabling the Benecol innovation	Groundbreaking food technology innovation for creating functional foods
1993	Clinical experiments of Benecol within the North Karelia Project start	Pioneering cooperation between business and North Karelia Project organisation
1995	Results of the clinical trial led by Professor Tatu Miettinen published in *NEJM* and Benecol launched in Finland	Inspiration for further development of nutrition science, functional food innovations, and academia-industry collaboration in Finland
1995	Finland joins the EU	Finnish food industry faces keener competition in the domestic market and realises potential benefits of collaboration
1996-2010		
1996	First ever technology programme in foods in Finland launched by Tekes	Creation of a novel collaboration platform for the food industry and the academia, provision of funding for academic research and private R&D projects
2001	Second technology programme in foods launched by Tekes	Provision of R&D funding, expertise and continued networking forums in order to aid the nascent functional foods sector
2008	Failure to establish Strategic Centre for Science, Technology and Innovation in Food and Nutrition	Crystallisation of the food industry's reluctance to invest in wider food industry collaboration. Functional foods framed under the broader field of well-being

Table 2. Cluster phases and institutional work

	Gestation phase: Institutional work to change food habits for imporoved public health, 1970s-late 1980s	**Pre-emergence phase:** Innovating at the interface between industries 1989-1995	**Lock-in phase:** Engaging industry through cluster programmes 1996-2010
Issue	Severe social problem	Technological problem	National competitiveness
Ideational work: Issue framing Counterfactual thinking	From negative diagnostic frame ("North Karelia has the highest mortality from heart disease in the world") to positive motivational frame ("Heart disease can be prevented by practical action", "Only you can change North Karelia") Heart disease can be prevented only by changing the entire social and psychical environment ("shotgun approach")	Focus on motivational framing to mobilize resources to solve the technical roadblock preventing the use of plant sterols for cholesterol-lowering in foods Blending of disciplinary knowledge and institutional logics of medicine, pulp and paper, and food chemistry to create a novel functional foods	From negative diagnostic frame ("Finnish food industry is inward looking and private sector R&D is minimal") to positive motivational frame ("Finland can be the Silicon Valley of Functional Foods", "Together we can make Finland a competitive forerunner in healthy nutrition") Little evidence for counterfactual thinking
Material work: Resource mobilization	Securing cognitive, social and material support for the project from micro (grassroots support for the project) to macro level (systematic changes in national legislation, governmental funding for 25 years)	Dedicating own work hours and free time for scientific exploration and for securing necessary organisational support for the project	Channelling material support through the cluster programmes (e.g. TEKES funding in the first programme €40M and in the second programme €37M)
Bridging work: Bridging Networking	Bridging between medical and behavioral social science (e.g. sociology and social psychology of persuasion) Networking with international scientists, WHO, national and local politicians, NGOs, industry, local health organisations and grassroots community	Bridging between medical science and food and wood chemistry Networking with actors across different sectors (food, pulp & paper, public health, funding organisations) and with company representatives to ensure necessary resources	Broad attempt to bridge between different knowledge bases and resources Catalyzing national networks for innovation and commercialization
Authentic leadership work: Authentic cluster leadership	Considering multiple sides of the complex issue and proposing positive solutions to empower the entire community to social change Being visible and interacting in person with different community organizations ("boots deep in the mud" philosophy)	Convincing others through in-depth expertise, innovative thinking, resilience, and altruism	Limited evidence for authentic leadership
Characteristics of institutional entrepreneurs	Young radical scientists with rebel spirit acting as agents of societal change	Curious and modest servants of science true to their inner scientific missions	Agents of public policy, consultant-type sparring partners